



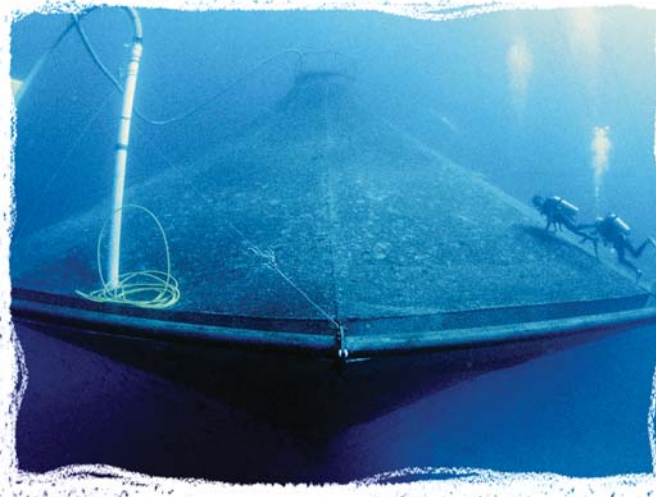
# SCIENCE SUPPORTING SUSTAINABLE AQUACULTURE

To compete in the global economy, Hawai'i's aquaculture industry must continue to develop and deploy advanced technologies. Such technologies, along with novel marketing strategies, will allow the Hawai'i aquaculture industry to overcome competitive constraints associated with limited land availability, labor costs and a high cost of living. The University of Hawai'i (UH) Sea Grant College Program's efforts in aquaculture development are reflective of the increased emphasis accorded this area in NOAA's strategic plan.

**Evaluating the Opportunities** — Seafood consumption in Hawai'i averages 45 pounds per person each year: three times that of the U.S mainland. Hawai'i imports 75 percent of the fish it consumes. Aquaculture now provides more than 25% of the seafood consumed worldwide. In the ten years ending in 2000, aquaculture revenues in Hawai'i more than tripled, growing from \$7 million to \$22 million. Previously, Hawai'i's stringent environmental regulations were considered a competitive constraint on aquaculture. Most aquaculturists now realize that reasonable, science-based guidance and regulations are essential to maintain water quality and limit disease spread, elements critical to successful farms.

**Understanding the Challenges** — The Hawai'i aquaculture industry is poised to incorporate advanced culture techniques for cost-effective production, target new food and ornamental market species, and diversify product lines for a more productive and profitable industry. There is a strong need for research, particularly to improve growth and disease resistance, reduce the environmental impacts of high density rearing, and increase the efficiency of feed utilization. There is also a need to build a skilled workforce and educate stakeholders. Current aquaculture knowledge must be disseminated effectively to potential farmers, researchers, students, the business community, government and the general public.

**Finding Solutions** — UH Sea Grant has provided new technical knowledge, trained many present-day leaders and scientists, and supported the development of this increasingly important segment of Hawai'i's economy. UH Sea



Grant supports aquaculture research and fosters opportunities for aquaculture business development in marine and freshwater ornamentals, black-lipped pearl oysters, open-ocean cage culture, and the revitalization of traditional Hawaiian fishponds. UH Sea Grant continues to leverage its aquaculture investment through extension support services. UH Sea Grant faculty

and extension specialists will facilitate cooperative efforts to assist commercial producers, and help insure the establishment and expansion of successful aquaculture enterprises.

## Reaping the Benefits

Through its leadership in aquaculture and partnership with university researchers, UH Sea Grant is prepared to support new and continuing efforts addressing:

**Farm Productivity** — Advanced culture techniques that result in efficient and cost-effective production must be developed. Providing technical assistance, the core of UH Sea Grant extension activities must continue through verbal consultation, written materials and on-site visits. Continued assistance will be provided within the state and the Pacific region.

**Industry Diversification** — UH Sea Grant can help to build the state's economy by facilitating efforts to attract companies involved in aquaculture technology development. This will be an area of growth internationally as aquaculture continues to provide an ever-larger fraction of the seafood supply; aquaculture industry development offers higher-paying jobs that typically employ university graduates. UH Sea Grant will also contribute to continued aquaculture diversification by increasing the number of species cultured for both food and ornamental markets and by encouraging new investment from beyond Hawai'i's shores. The Program's specialists will help increase the amount of research and development initiatives that will ultimately position Hawai'i as a primary center for technology development.





Culture technology development will include: new aquaculture pharmaceuticals; live food production; food fish species, such as the Russian sturgeon (*Acipenser gueldenstaedti*) and the mollusk apple snail (*Pomacea canaliculata*); freshwater and marine ornamentals; black-lipped pearl oysters (*Pinctada margaritifera*); open-ocean cage culture; and the revitalization of Hawaiian fishponds.

**Freshwater Ornamentals** — UH Sea Grant's work at the Windward Community College Aquaculture Complex is helping to improve the rearing of freshwater ornamental fish. Projects completed at this facility by two University of Hawai'i students have received national awards for aquaculture research. Students of all ages now visit the facility to learn about aquaculture.

**Black Pearls** — The black-lipped pearl oyster (*Pinctada margaritifera*) industry began in French Polynesia with the first harvest in 1976. Today, the industry in French Polynesia alone is worth approximately US\$140 million per year. UH Sea Grant fosters opportunities for aquaculture business development based on black-lipped pearl oyster farming for pearls and nacre in Hawai'i and the U.S.-affiliated Pacific islands.

**Black Coral** — UH Sea Grant researchers map and monitor the undersea black coral fields off Maui. In contrast to ravaged coral resources in other parts of the world, Hawai'i's \$15 million per year black coral fishery has been managed sustainably for over 40 years. Employing a successful amalgam of science and business, the successful local regulation of this unique fishery is a model in conservation for an age plagued by short-sighted ocean exploitation.

**Open-Ocean Cage Culture** — The *moi*, or Pacific threadfin, is indigenous to Hawai'i and was once reserved solely for its royalty. UH Sea Grant researchers have used state-of-the-art marine finfish aquaculture technologies to test a giant sea cage submerged two miles offshore and stocked with 70,000 *moi*. The success of this

project has introduced Hawai'i to a new technology with a potential value of \$400 million per year. Now in its third phase, the research cage has been leased to a commercial venture. With a lease location near the original research site, this business firm has become the first fully permitted open-ocean aquaculture site in the U.S.

**Hawaiian Fishponds** — UH Sea Grant aquaculture agents and specialists are using the Hawaiian fishpond as a motivational tool to help students learn about science, social sciences and language arts. In collaboration with the Pacific American Foundation, and with support from the U.S. Department of Education, UH Sea Grant works with Hawaiian fishpond projects and operators, school-teachers, historians, and Hawaiian language and culture experts to develop curricula that will introduce, inform and inspire students through traditional Hawaiian practices.



**Aquaculture as Education** — UH Sea Grant-supported research projects have provided education to many graduate and undergraduate students who have emerged as leaders in aquaculture in the state, nation and worldwide. UH Sea Grant aquaculture extension activities provide technical assistance to educators interested in using aquaculture as a teaching tool and a basis for curriculum development. The main advantage of this hands-on approach, which includes induction of catfish spawning and water-quality assessment, provides students with experiential learning and exposes them to anatomy, endocrinology, biology, mathematics and report writing.



## MISSION

The Aquaculture Focus Group suggests that the food and ornamental segments of Hawai'i's marine and freshwater aquaculture industry will constitute a major part of the state's diversified and sustainable economy.

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